

Attorney Docket No.: 01CON334P
Application Serial No.: 09/782,791

In the Claims:

Claim 1 (previously presented): A noise attenuation system for speech coding comprising:

- an encoder disposed to receive a digitized signal, the encoder to provide a bitstream based upon a speech coding of the digitized signal;
- where the speech coding determines at least one gain scaling a portion of the digitized signal; and
- where the encoder adjusts the at least one gain as a function of noise characteristic for attenuating background noise in at least one frame,
- wherein the at least one gain is adjusted according to a gain factor, the gain factor facilitating time-domain background noise attenuation.

Claim 2 (original): The noise attenuation system according to Claim 1, where the speech coding comprises code excited linear prediction (CELP).

Claim 3 (original): The noise attenuation system according to Claim 1, where the speech coding comprises extended code excited linear prediction (eX-CELP).

Claim 4 (original): The noise attenuation system according to Claim 1, where the at least one gain is adjusted prior to quantization by the speech coding.

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Claim 5 (previously presented): The noise attenuation system according to Claim 1, where the encoder adjusts the at least one gain according to the gain factor.

Claim 6 (original): The noise attenuation system according to Claim 5, where the gain factor G_f is determined by the equation,

$$G_f = 1 - C \cdot \text{NSR}$$

where NSR has a value of about 1 when the portion comprises essentially background noise, where NSR is the square root of background noise energy divided by signal energy when the portion comprises speech, and where C is in the range of 0 through 1.

Claim 7 (original): The noise attenuation system according to Claim 6, where C is in the range of about 0.4 through about 0.6.

Claim 8 (original): The noise attenuation system according to Claim 6, further comprising a voice activity detector (VAD) operatively connected to the encoder, the VAD to determine when the portion comprises speech.

Claim 9 (original): The noise attenuation system according to Claim 5, where the gain factor is based on a running mean.

Claim 10 (original): The noise attenuation system according to Claim 9, where the running mean G_{f_new} is determined by the equation,

$$G_{f_new} = \alpha \cdot G_{f_old} + (1 - \alpha) \cdot G_{f_current}$$

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where Gf_{old} is a preceding gain factor for a preceding portion of the digitized signal, where $Gf_{current}$ is the gain factor based on the portion of the digitized signal, and where $0 \leq \alpha < 1$.

Claim 11 (original): The noise attenuation system according to Claim 10, where α is equal to about 0.5.

Claim 12 (original): The noise attenuation system according to Claim 1, where the portion of the digitized signal is one of a frame, a sub-frame, and a half frame.

Claim 13 (original): The noise attenuation system according to Claim 1, where the encoder comprises a digital signal processing (DSP) chip.

Claim 14 (original): The noise attenuation system according to Claim 13, further comprising a preprocessor operatively connected to receive the digitized signal from the analog-to-digital converter, the preprocessor to modify spectral magnitudes of the digitized signal to reduce noise, the preprocessor to provide a noise-suppressed digitized signal to the encoder.

Claim 15 (original): The noise attenuation system according to Claim 1, further comprising a decoder operatively connected to receive the bitstream from the encoder, the decoder to provide a reconstructed signal based upon the bitstream.

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Claim 16 (previously presented): A noise attenuation system for speech coding comprising:

a decoder disposed to receive a bitstream, the decoder to provide a reconstructed signal based upon a speech decoding of the bitstream;

where the speech decoding determines at least one gain scaling a portion of the reconstructed signal; and

where the encoder adjusts the at least one gain as a function of noise characteristic for attenuating background noise in at least one frame,

wherein the at least one gain is adjusted according to a gain factor, the gain factor facilitating time-domain background noise attenuation.

Claim 17 (original): The noise attenuation system according to Claim 16, where the speech decoding comprises code excited linear prediction (CELP).

Claim 18 (original): The noise attenuation system according to Claim 16, where the speech decoding comprises extended code excited linear prediction (eX-CELP).

Claim 19 (original): The noise attenuation system according to Claim 16, where the at least one gain is adjusted after decoding by the speech decoding.

Claim 20 (previously presented): The noise attenuation system according to Claim 16, where the decoder adjusts the at least one gain according to the gain factor.

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Claim 21 (original): The noise attenuation system according to Claim 20, where the gain factor G_f is determined by the equation,

$$G_f = 1 - C \cdot \text{NSR}$$

where NSR has a value of about 1 when the portion comprises essentially background noise, where NSR is the square root of background noise energy divided by signal energy when the portion comprises speech, and where C is in the range of 0 through 1.

Claim 22 (original): The noise attenuation system according to Claim 21, where C is in the range of about 0.4 through about 0.6.

Claim 23 (original): The noise attenuation system according to Claim 21, further comprising a voice activity detector (VAD) operatively connected to the decoder, the VAD to determine when the portion comprises speech.

Claim 24 (original): The noise attenuation system according to Claim 20, where the gain factor is based on a running mean.

Claim 25 (original): The noise attenuation system according to Claim 24, where the running mean $G_{f_{\text{new}}}$ is determined by the equation,

$$G_{\text{new}} = \alpha \cdot G_{f_{\text{old}}} + (1 - \alpha) \cdot G_{f_{\text{current}}}$$

where $G_{f_{\text{old}}}$ is a preceding gain factor for a preceding portion of the reconstructed signal, where

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$G_{f_{\text{current}}}$ is the gain factor based on the portion of the reconstructed signal, and where $0 \leq \alpha < 1$.

Claim 26 (original): The noise attenuation system according to Claim 25, where α is equal to about 0.5.

Claim 27 (original): The noise attenuation system according to Claim 16, where the portion of the reconstructed signal is one of a frame, a sub-frame, and a half frame.

Claim 28 (original): The noise attenuation system according to Claim 16, where the decoder comprises a digital signal processing (DSP) chip.

Claim 29 (original): The noise attenuation system according to Claim 16, further comprising an encoder operatively connected to provide the bitstream to the decoder.

Claim 30 (previously presented): A noise attenuation system for speech coding comprising:

an encoder disposed to receive a digitized signal, the encoder to provide a bitstream based upon a speech coding of the digitized signal, where the speech coding determines at least one gain scaling a portion of the digitized signal, and where the encoder adjusts the at least one gain as a function of noise characteristic; and

a decoder operatively connected to receive the bitstream from the encoder, where the decoder provides a reconstructed signal based upon a speech decoding of the bitstream, where

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the speech decoding reconstructs the at least one gain scaling the portion of the digitized signal, and where the decoder adjusts the at least one gain as a function of noise characteristic for attenuating background noise in at least one frame, wherein the at least one gain is adjusted according to a gain factor, the gain factor facilitating time-domain background noise attenuation.

Claim 31 (original): The noise attenuation system according to Claim 30, where the speech coding and the speech decoding comprise code excited linear prediction (CELP).

Claim 32 (original): The noise attenuation system according to Claim 30, where the speech coding and the speech decoding comprise extended code excited linear prediction (eX - CELP).

Claim 33 (original): The noise attenuation system according to Claim 30, where at least one of the encoder and the decoder adjusts the at least one gain.

Claim 34 (original): The noise attenuation system according to Claim 30, where at least one of the encoder and the decoder adjusts the gain according to a gain factor.

Claim 35 (original): The noise attenuation system according to Claim 34, where the gain factor G_f is determined by the equation,

$$G_f = 1 - C \cdot NSR$$

where NSR has a value of about 1 when the portion comprises essentially background noise,

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where NSR is the square root of background noise energy divided by signal energy when the portion comprises speech, and where C is in the range of 0 through 1.

Claim 36 (original): The noise attenuation system according to Claim 35, where C is in the range of about 0.4 through about 0.6 when one of the encoder and the decoder adjusts the gain by the gain factor.

Claim 37 (original): The noise attenuation system according to Claim 35, where C is in the range of about 0.2 through about 0.4 when the encoder and the decoder adjust the gain by the gain factor.

Claim 38 (previously presented): The noise attenuation system according to Claim 35, further comprising a voice activity detector (VAD) operatively connected to at least one of the encoder and the decoder, the VAD to determine when the portion comprises speech.

Claim 39 (original): The noise attenuation system according to Claim 34, where the gain factor is based on a running mean.

Claim 40 (original): The noise attenuation system according to Claim 39, where the running mean Gf_{new} is determined by the equation,

$$Gf_{new} = \alpha \cdot Gf_{old} + (1 - \alpha) \cdot Gf_{current}$$

where Gf_{old} is a preceding gain factor for a preceding portion of the digitized signal, where

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$G_{f_{\text{current}}}$ is the gain factor based on the portion of the digitized signal, and where $0 \leq \alpha < 0.5$.

Claim 41 (original): The noise attenuation system according to Claim 40, where α is equal to about 0.5.

Claim 42 (original): The noise attenuation system according to Claim 30, where the portion of the digitized signal is one of a frame, a sub-frame, and a half frame.

Claim 43 (original): The noise attenuation system according to Claim 30, further comprising:

an analog-to-digital converter disposed to receive and convert an analog signal into the digitized signal; and

a preprocessor operatively connected to provide the digitized signal from the analog-to-digital converter to the encoder, the preprocessor to modify spectral magnitudes of the digitized signal to reduce noise.

Claim 44 (original): The noise attenuation system according to Claim 30, where at least one of the encoder and the decoder comprises a digital signal processing (DSP) chip.

Claim 45 (previously presented): A method of attenuating noise in a speech coding system, comprising:

- (a) segmenting a digitized signal into at least one portion;

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- (b) determining at least one gain scaling the digitized signal within the one portion;
- (c) adjusting the at least one gain as a function of noise characteristic; and
- (d) quantizing the at least one gain into a group of at least one bit for a bitstream,

where the at least one gain is adjusted as a function of noise characteristic for attenuating background noise in at least one frame,

wherein the at least one gain is adjusted according to a gain factor, the gain factor facilitating time-domain background noise attenuation.

Claim 46 (original): The method of attenuating noise according to Claim 45, where the speech coding system comprises code excited linear prediction (CELP).

Claim 47 (original): The method of attenuating noise according to Claim 45, where the speech coding system comprises extended code excited linear prediction (eX-CELP).

Claim 48 (original): The method of attenuating noise according to Claim 45, where step (a) further comprises:

- sampling an analog signal to produce the digitized signal; and
- modifying the spectral magnitudes of the digitized signal to reduce noise.

Claim 49 (previously presented): The method of attenuating noise according to Claim 45, where step (c) further comprises adjusting the at least one gain according to the gain factor.

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Claim 50 (original): The method of attenuating noise according to Claim 49, where the gain factor G_f is determined by the equation

$$G_f = 1 - C \cdot \text{NSR}$$

where NSR has a value of about 1 when the portion comprises essentially background noise, where NSR is the square root of background noise energy divided by signal energy when the portion comprises speech, and where C is in the range of 0 through 1.

Claim 51 (original): The method of attenuating noise according to Claim 49, where the gain factor is based on a running mean.

Claim 52 (original): The method of attenuating noise according to Claim 51, where the running mean $G_{f_{\text{new}}}$ is determined by the equation,

$$G_{f_{\text{new}}} = \alpha \cdot G_{f_{\text{old}}} + (1 - \alpha) \cdot G_{f_{\text{current}}}$$

where $G_{f_{\text{old}}}$ is a preceding gain factor for a preceding portion of the digitized signal, where $G_{f_{\text{current}}}$ is the gain factor based on the portion of the digitized signal, and where $0 \leq \alpha < 1$.

Claim 53 (original): The method of attenuating noise according to Claim 52, where α is equal to about 0.5.

Claim 54 (original): The method of attenuating noise according to Claim 45, where the portion is one of a frame, a sub-frame, and a half frame.

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Claim 55 (previously presented): A method of attenuating noise in a speech coding system, comprising:

- (a) decoding at least one gain from a group of at least one bit in a bitstream;
- (b) adjusting the at least one gain as a function of noise characteristic; and
- (c) assembling the at least one gain into a portion of a reconstructed speech signal, where the at least one gain is adjusted as a function of noise characteristic for attenuating background noise in at least one frame,

wherein the at least one gain is adjusted according to a gain factor, the gain factor facilitating time-domain background noise attenuation.

Claim 56 (original): The method of attenuating noise according to Claim 55, where the speech coding system comprises code excited linear prediction (CELP).

Claim 57 (original): The method of attenuating noise according to Claim 55, where the speech coding system comprises extended code excited linear prediction (eX-CELP).

Claim 58 (previously presented): The method of attenuating noise according to Claim 55, where step (b) further comprises adjusting the at least one gain according to the gain factor.

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Claim 59 (original): The method of attenuating noise according to Claim 58, where the gain factor G_f is determined by the equation

$$G_f = 1 - C \cdot \text{NSR}$$

where NSR has a value of about 1 when the portion comprises essentially background noise, where NSR is the square root of background noise energy divided by signal energy when the portion comprises speech, and where C is in the range of 0 through 1.

Claim 60 (original): The method of attenuating noise according to Claim 58, where the gain factor is based on a running mean.

Claim 61 (original): The method of attenuating noise according to Claim 60, where the running mean $G_{f_{\text{new}}}$ is determined by the equation,

$$G_{f_{\text{new}}} = \alpha \cdot G_{f_{\text{old}}} + (1 - \alpha) \cdot G_{f_{\text{current}}}$$

where $G_{f_{\text{old}}}$ is a preceding gain factor for a preceding portion of the digitized signal, where $G_{f_{\text{current}}}$ is the gain factor based on the portion of the digitized signal, and where $0 \leq \alpha < 1$.

Claim 62 (original): The method of attenuating noise according to Claim 61, where α is equal to about 0.5.

Claim 63 (previously presented): A method of attenuating noise in a speech coding system, comprising:

- (a) segmenting a digitized signal into at least one portion;

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- (b) determining at least one gain representing the digitized signal within the one portion;
 - (c) pre-adjusting the at least one gain as a function of noise characteristic;
 - (d) quantizing the at least one gain into a group of at least one bit for a bitstream.
 - (e) decoding the at least one gain from the group of at least one bit in the bitstream;
 - (f) post-adjusting the at least one gain as a function of noise characteristic; and
 - (g) assembling the at least one gain into a reconstructed speech signal,
- where the at least one gain is adjusted as a function of noise characteristic for attenuating background noise in at least one frame,
- wherein the at least one gain is adjusted according to a gain factor, the gain factor facilitating time-domain background noise attenuation.

Claim 64 (original): The method of attenuating noise according to Claim 63, where the speech coding system comprises code excited linear prediction (CELP).

Claim 65 (original): The method of attenuating noise according to Claim 63, where the speech coding system comprises extended code excited linear prediction (eX-CELP).

Claim 66 (previously presented): The method of attenuating noise according to Claim 63, where at least one of (c) and (f) further comprises adjusting the at least one gain according to the gain factor.

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Claim 67 (original): The method of attenuating noise according to Claim 66, where the gain factor G_f is determined by the equation

$$G_f = 1 - C \cdot \text{NSR}$$

where NSR has a value of about 1 when the portion comprises essentially background noise, where NSR is the square root of background noise energy divided by signal energy when the portion comprises speech, and where C is in the range of 0 through 1.

Claim 68 (original): The method of attenuating noise according to Claim 66, where the gain factor is based on a running mean.

Claim 69 (original): The method of attenuating noise according to Claim 68, where the running mean $G_{f_{\text{new}}}$ is determined by the equation,

$$G_{f_{\text{new}}} = \alpha \cdot G_{f_{\text{old}}} + (1 - \alpha) \cdot G_{f_{\text{current}}}$$

where $G_{f_{\text{old}}}$ is a preceding gain factor for a preceding portion of the digitized signal, where $G_{f_{\text{current}}}$ is the gain factor based on the portion of the digitized signal, and where $0 \leq \alpha < 1$.

Claim 70 (original): The method of attenuating noise according to Claim 69, where α is equal to about 0.5.